Microwave Mega-Node

KAV ELECTRIC COMPANY

OPERATING
AND MAINTENANCE MANUAL

Microwave Mega-Node

KAY ELECTRIC COMPANY
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FIG. I.I, MICROWAVE MEGA-NODE

SECTION I
FUNCTION AND DESCRIPTION

1.1 INTRODUCTION.

The MICROWAVE MEGA-NODE comprises a series of random noise generators operating in the frequency range of 1120 through 26,500 mc. The noise output power depends upon the type of gas discharge lamp selected; fluorescent lamps producing 15.8 db, argon lamps producing 15.3 db, and neon lamps producing 18.1 db. These random noise sources provide a primary standard in the microwave regions.

This instrument may be used for determining the noise figure of an equipment, for making signal calibration measurements, or for receiver or amplifier gain tests. It is also useful for checking the overall performance of radar systems. When used for noise measurements, the noise figure is obtained by comparing the noise output of a system with the additional noise output introduced by the MICROWAVE MEGA-NODE. Comparative receiver sensitivity measurements may be made if the receiver is not excessively noisy. The simplicity of operation and the limited number of controls make this instrument practical for production line testing, while its accuracy makes it a useful laboratory tool.

1.2 FEATURES.

The MICROWAVE MEGA-NODE utilizes fluorescent, argon, or neon gas discharge tubes which produce substantially monochromatic light. The use of standard AN flanges at the ends of the waveguides facilitates equipment interconnections. A thermometer, mounted on the side of waveguides employing fluorescent lamps, supplies data for the correction factor necessary when fluorescent lamps are used. A 0 - 300 milliammeter provides direct reading of filament and anode current.

1.3 SPECIFICATIONS.

Operating Range and VSWR:

WAVEGUIDE NUMBER	LAMP SIZE			RECOMMENDED RANGE $TE_{0,2}$	VSWR
	FLUORESCENT	ARGON	NEON		
RG-69/U	T8, 30 watt			1.12 - 1.7 kmc	< 1.3:1
RG-69/U	GE-F14T12W 14 watt	6881	TD-62	1.2 - 1.4 kmc	1.07:1 max.
RG-104/U	T8, 30 watt			1.7 - 2.2 kmc	< 1.3:1
RG-112/U	T8, 30 watt			2.3 - 3.3 kmc	< 1.2:1
RG-48/U	T8, 15 watt	6358	CNT S18D1	2.6 - 3.95 kmc	F> 2.79, 1.1:1; 1.2:1 max
RG-49/U	T5, 8 watt	6356	7989	3.95 - 5.85 kmc	< 1.1:1
RG-50/U	T5, 8 watt	6356	7989	5.85 - 8.2 kmc	F> 7.5, 1.1:1; 1.2:1 max.
RG-51/U	T5, 8 watt	6357	6882	7.05 - 10. 0 kmc	< 1.1:1
RG-52/U	T5, 8 watt	6357	6882	8.2 - 12.4 kmc	< 1.1:1
RG-91/U		6359	7990	12.4 - 18.0 kmc	mean < 1.1:1; max. 1.2:1
RG-53/U		6359	7990	18.0 - 26.5 kmc	mean < 1.1:1; max. 1.2:1

Noise Output Above Thermal Noise:

Fluorescent: 15.8 ±0.5 db at 32°C.

Argon: 15.3 ±0.5 db at rated current.

Neon: 18.1 ±0.5 db at rated current.

Power Requirements:

Fluorescent: Approximately 70 watts, 117 volts (±10%), 50 to 60 cps ac power input.

Argon: Approximately 75 watts, 117 volts (±10%), 50 to 60 cps ac power input.

Neon: Approximately 80 watts, 117 volts (±10%), 50 to 60 cps ac power input.

Mechanical Specifications:

Waveguide	Flange	Weight	Dimensions (inches)
RG-69/U	UG-417/U	35 LBS.	43 x 9½ x 11
RG-69/U	UG-417/U	11 LBS.	5 7/8 x 6 x 6
RG-104/U	UG-435/U	25 LBS.	43 x 7¼ x 8½
RG-112/U	UG-553/U	30 LBS.	43¾ x 7 1/8 x 10½
RG-48/U	UG-214/U	11 LBS.	23¾ x 5 x 8½
RG-49/U	UG-149/U	7 LBS.	23¾ x 4 x 5 3/8
RG-50/U	UG-344/U	5 LBS.	23½ x 3½ x 5¼
RG-51/U	UG-51/U	3 LBS.	18 x 3 x 4¾
RG-52/U	UG-39/U	2½ LBS.	18 x 3 x 4¾
RG-91/U	UG-149/U	1½ LBS.	12½ x 2¾ x 5½
RG-53/U	UG-425/U	1¼ LBS.	12¼ x 2½ x 5½

1.4 EQUIPMENT SUPPLIED.

The waveguide assembly, a hardwood stand, a gas discharge lamp, and the interconnecting cable, which supplies power to the gas discharge lamp, is supplied. The power supply, if desired must be purchased separately. Other auxiliary equipment

SECTION II
OPERATION AND APPLICATION

2.1 FUNCTION OF CONTROLS AND TERMINALS.

CONTROL	POSITION	FUNCTION
ON - OFF switch S-1	ON	This DPST switch controls ac power input to the instrument. When this switch is in the ON position, the instrument is energized and operating voltages are supplied to the circuitry.
	OFF	When the switch is in this position, power is removed from the instrument and all circuitry is de-energized.
START switch S-2	ON	When the switch is in this position, ignition voltage is supplied to the gas discharge lamp.
	OFF	When the switch is in the OFF position, running potential is applied across the gas discharge lamp.
INCREASE control T-1	Variable	This variable transformer controls the magnitude of the current passing through the gas discharge tube. Instructions for the use of this control appears in the section titled "Preliminary Operating Instructions" of this manual.
METER M-1		This dc milliammeter, calibrated from 0 to 300 ma, is used when adjusting the anode current and filament current to the proper level. When the START switch is in the ON position, the meter is connected in series with one filament and records the current through it. When the START switch is in the OFF position, the meter is connected in sèries with the lamp itself and records the current through it.
Thermometer		This accurately calibrated centigrade thermometer is permanently attached to the side of the waveguide when fluorescent gas discharge tubes are used. It has no control over the MICROWAVE MEGANODE itself, but is used only to obtain an accurate indication of the temperature during a test so that the proper temperature correction factor can be applied to the data obtained from the test.
Filament Current control R-7	Variable	This pot, located on back of chassis, is used to set the filament current of argon and neon tubes. It is not adjusted for fluorescent lamps. The proper use of this control is described in the section titled "Preliminary Operating Instructions" of this manual.

2.2 GENERAL INSTRUCTIONS.

As soon as the MICROWAVE MEGA-NODE is received, it should be visually inspected to determine that the instrument was not damaged during shipment. A careful check of packing case contents should also be made to insure removal of all items shipped. Shortage or damage should be reported immediately to the carrier and the Kay Electric Company, or its representative in your area.

2.3 INSTALLATION.

Installation presents no particular problems since the unit is designed for bench-top operation. It is recommended that sufficient space be allotted for the instrument being tested and the associated equipment. The operating area selected should be as free as possible from vibration, due to the presence of machinery, or other sources of vibration. Extreme variations of ambient temperature and an environment having excessive humidity should also be avoided. Observation of these precautions will result in the user realizing optimum performance of the equipment.

2.4 INTERCONNECTION DATA.

Interconnections between the MICROWAVE MEGA-NODE, the associated equipment, and the instrument being examined will depend on a number of different factors, such as; the type of output power measuring device, the type of test being made, and the requirements of the instrument being examined. Under all methods of operation, the MICROWAVE MEGA-NODE power supply must be connected to a 117 volt source, and the interconnecting cable which is supplied with the equipment must be connected between the power supply and the gas discharge lamp in the waveguide assembly. The flanges at the ends of the waveguide should be bolted to the flange of the input waveguide of the system. Either end of the MICROWAVE MEGA-NODE waveguide may be used. Interconnection diagrams are shown in the Application and Operation section of this manual.

2.5 PRELIMINARY OPERATING INSTRUCTIONS.

A. Fluorescent Lamps.

Step 1 - Connect the equipment according to the test being made (see Sections 2.3 and 2.4).

Step 2 - Turn ON - OFF switch to ON. The adjacent indicator lamp should light immediately.

Step 3 - Turn INCREASE control 3/4 clockwise.

Step 4 - Depress the START switch momentarily, then release; the fluorescent lamp should ignite. If the lamp does not ignite depress the START switch again and hold it down slightly longer. Repeat until the lamp ignites.

Step 5 - Adjust INCREASE control until the meter (M-1) indicates the proper lamp current for the desired frequency spectrum (see Fig. 2.1 thru 2.5). The MICROWAVE MEGA-NODE is now producing random noise across the entire useful frequency range of of the waveguide.

Step 6 - Allow 15 minutes for the instrument to warm up and stabilize.

Step 7 - Record the reading of the thermometer. Note: The MICROWAVE MEGA-NODES equipped with fluorescent lamps have a temperature correction factor of 0.05 db per degree centigrade. Thus the output power in decibels, P_{out} is:

$$P_{out} = 15.84 - 0.05\ (T-32)$$

Where T = the reading on the thermometer in degrees centigrade. The thermometer reading should be checked each time a measurement is made.

B. Argon Lamps.

Step 1 - Connect the equipment according to the test being made (see Sections 2.6 and 2.7).

Step 2 - Turn the ON - OFF switch to ON. The adjacent indicator lamp should light immediately.

Step 3 - Set the INCREASE control 3/4 clockwise.

Step 4 - Depress the START switch.

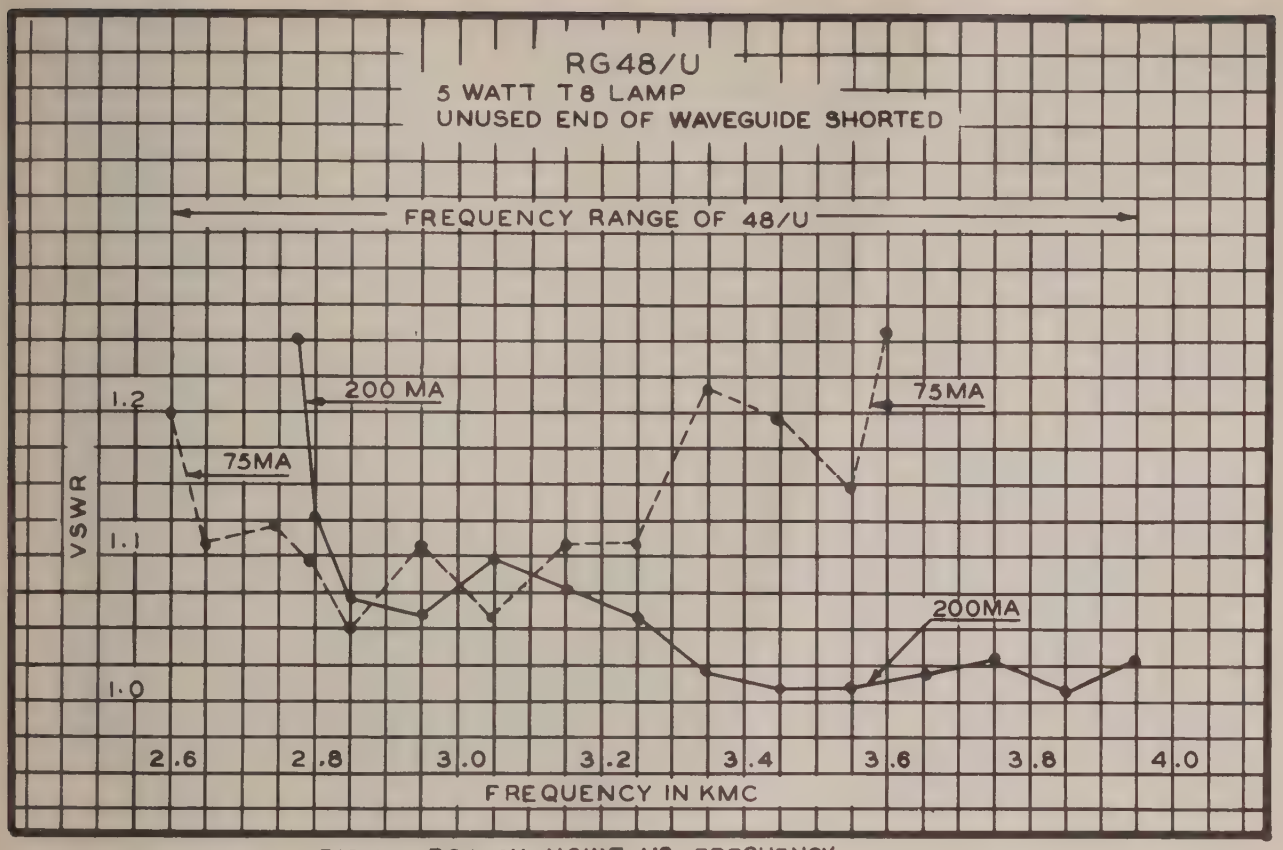


FIG. 2.1 RG/48U VSWR VS FREQUENCY

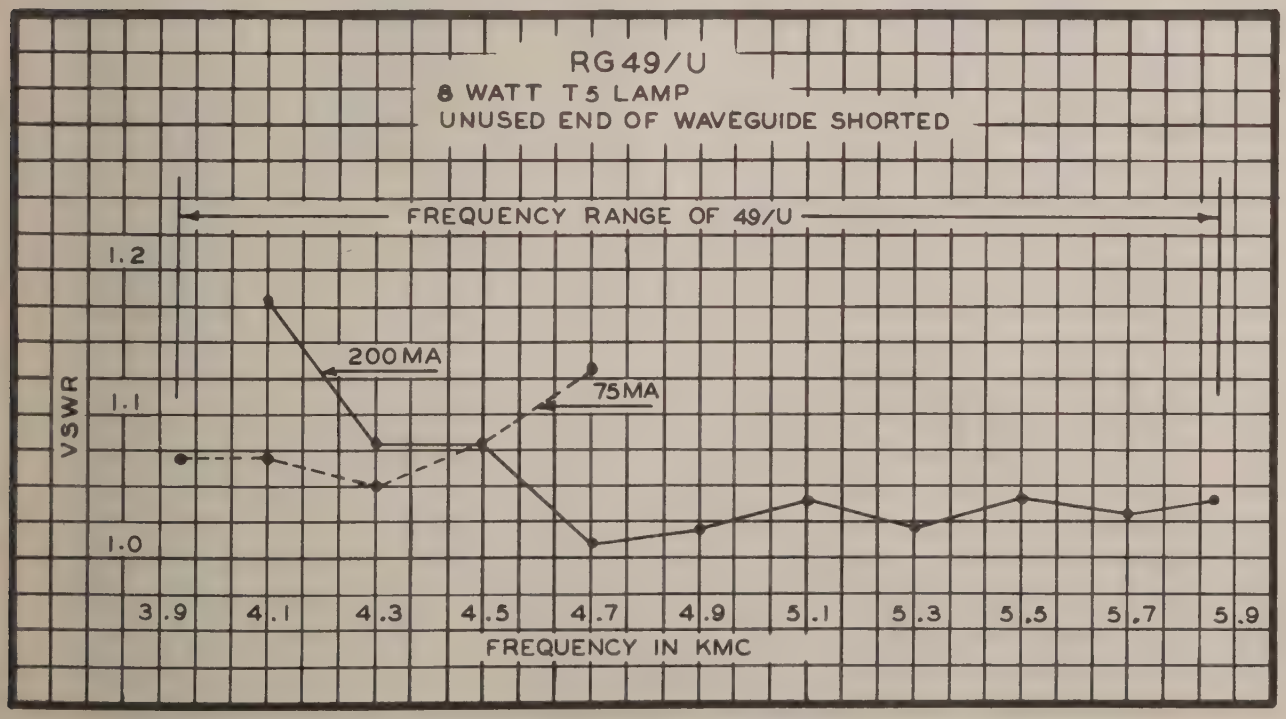


FIG. 2.2 RG/49U VSWR VS FREQUENCY

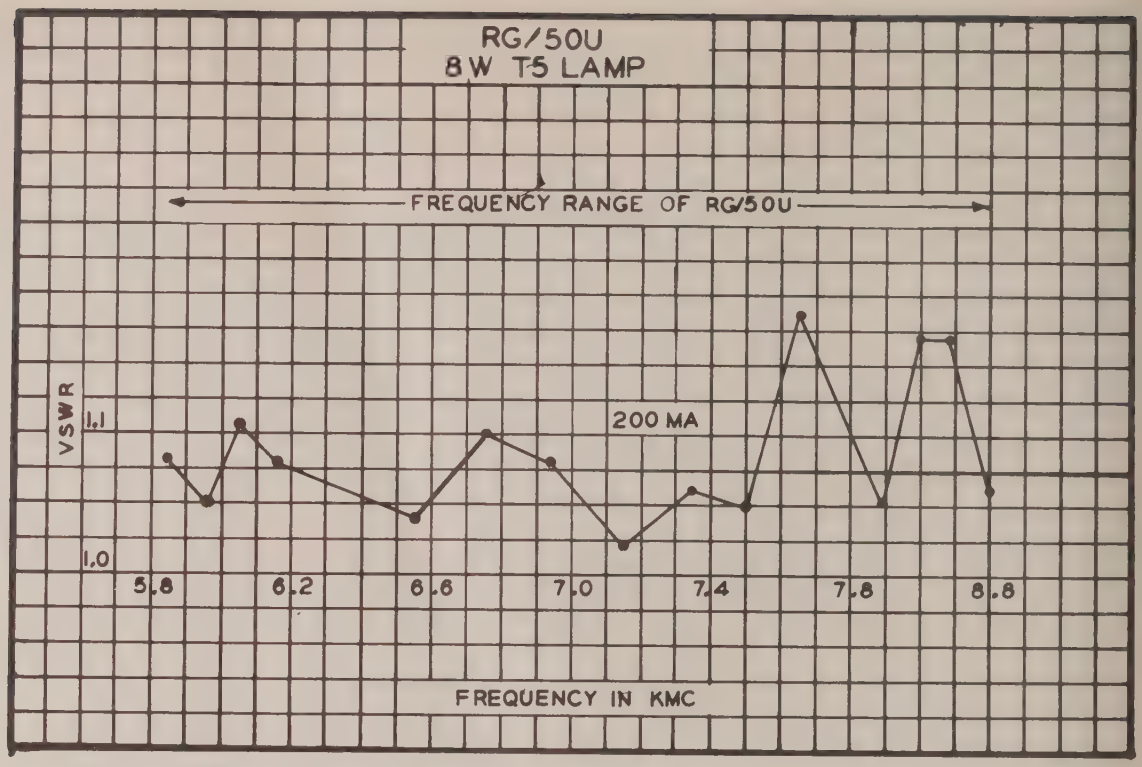


FIG. 2.3 RG/50 U VSWR VS. FREQUENCY

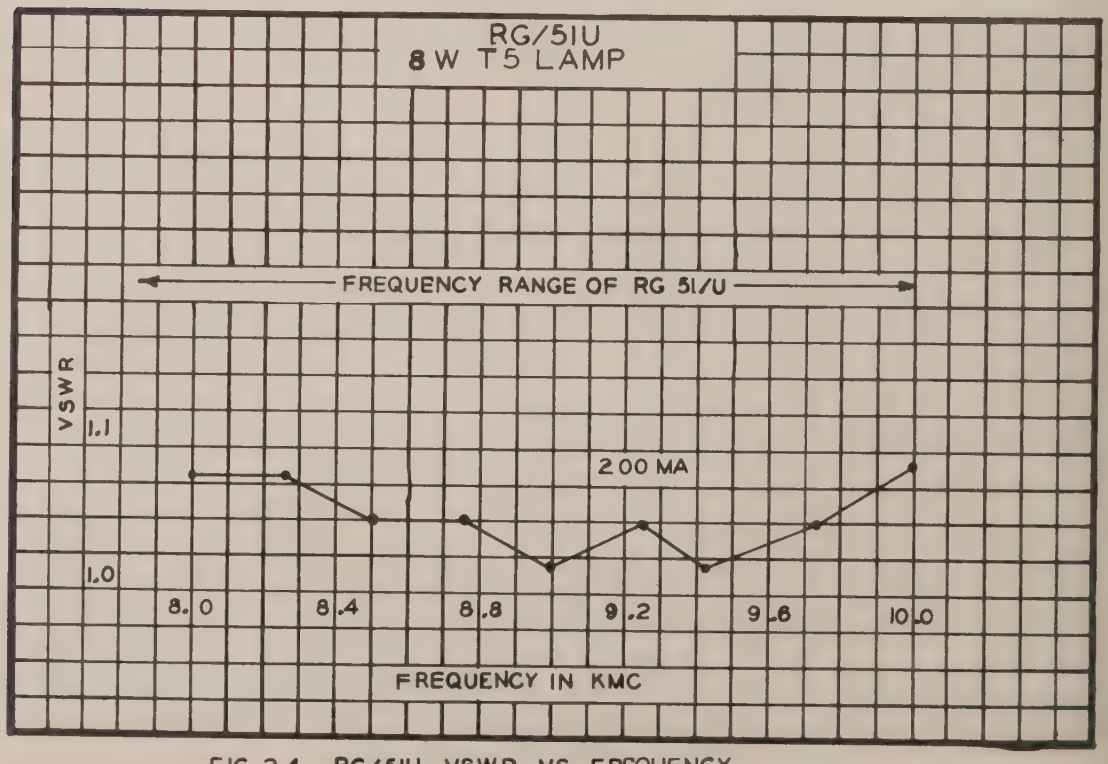


FIG. 2.4 RG/51U VSWR VS. FREQUENCY

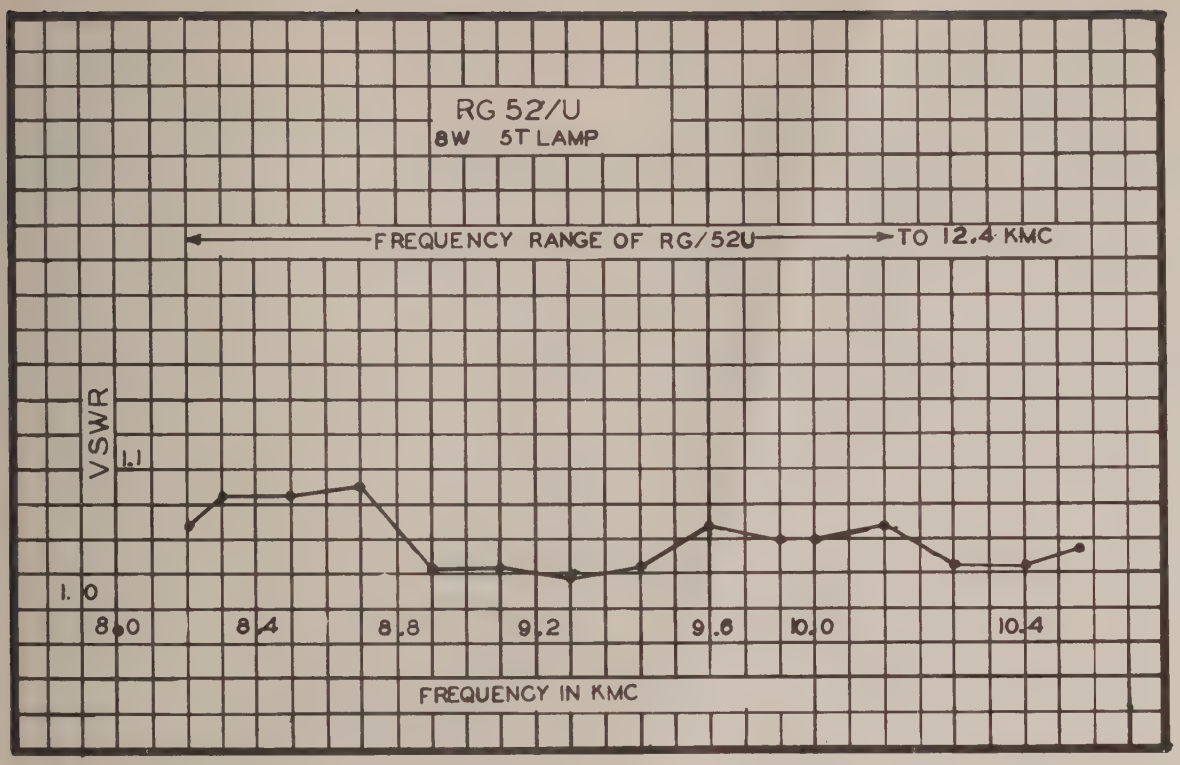


FIG.2.5 RG/52U VSWR VS FREQUENCY

Step 5 - Adjust R-7 (accessible from the rear of the cabinet) to limit the filament current supplied to the argon lamp. The filament current may be read directly from the meter (M-1), with the START switch still depressed. Correct filament currents for the various types of argon lamps are shown in Fig. 2.6.

Step 6 - Release the START switch. Argon lamp should ignite. If the lamp does not ignite, depress the START switch again and hold it down for a longer interval. Repeat until the lamp ignites.

Step 7 - Set the INCREASE control to limit the anode current to the value indicated in Fig. 3.6 for the type of argon lamp being used. The anode current is read directly from the meter (M-1).

Step 8 - Allow 15 minutes for the instrument to warm up and stabilize.

* * * * *

C. Neon Lamps.

Step 1 - Connect the equipment according to the test being made (See Sections 2.6 and 2.7).

Step 2 - Turn the ON - OFF switch to ON. The adjacent indicator lamp should light up immediately.

Step 3 - Set the INCREASE control about 3/4 fully clockwise.

Step 4 - Depress the START switch.

Step 5 - Adjust R-7 (located at rear of chassis) until meter (M-1) reads proper filament current as specified in Fig. 2.7.

Step 6 - Release the START switch. The neon lamp should ignite. If the lamp does not ignite, depress the START switch again and hold it down for a longer interval. Repeat until the lamp ignites.

Step 7 - Adjust the INCREASE control until the meter reads the proper anode current as specified in Fig. 2.7.

FIG. 2.6, TABLE OF ARGON LAMP CHARACTERISTICS*

CHARACTERISTIC	6356	6357	6358	6359	6881
ANODE CURRENT, MA DC	250	200	250	200	250
FILAMENT CURRENT, MA DC	170	170	300	170	300
TUBE DISSIPATION WATTS	20	17	22	13	16
TUBE VOLTAGE DROP, V DC	80	85	90	65	65
AMBIENT TEMPERATURE RANGE	-40 TO +165°F				

*NOTE: ALL MEASUREMENTS GIVEN ARE APPROXIMATE VALUES.

FIG. 2.7, TABLE OF NEON LAMP CHARACTERISTICS*

CHARACTERISTIC	6882	CNT S18D1	7989	7990	TD-62
ANODE CURRENT, MA DC	200	250	250	200	250
FILAMENT CURRENT, MA DC	170	250	170	170	300
TUBE DISSIPATION, WATTS	23	25	28	20	43
TUBE VOLTAGE DROP, V DC	115	100	110	100	130
AMBIENT TEMPERATURE RANGE	-40 TO +165°F				

*NOTE: ALL MEASUREMENTS GIVEN ARE APPROXIMATE VALUES.

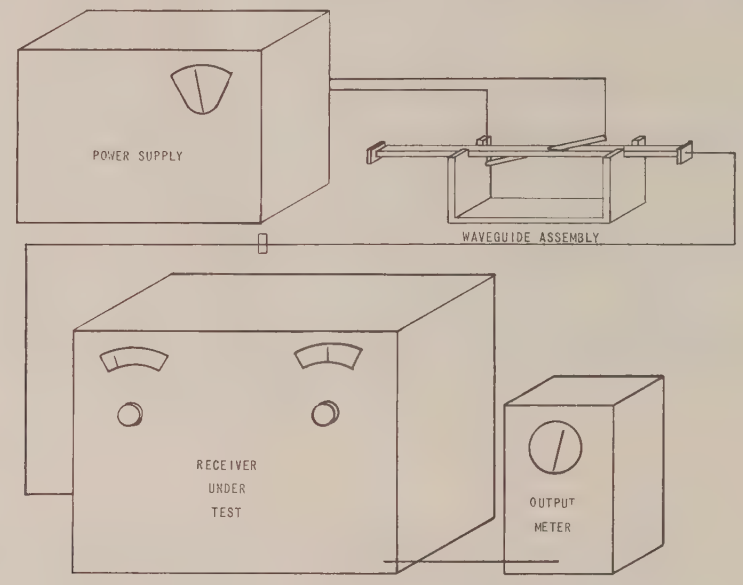


FIG. 2.8, INTERCONNECTION DIAGRAM FOR MICROWAVE MEGA-NODE USING DIRECT COMPARISON TECHNIQUES.

2.6 MEASUREMENT OF NOISE FIGURE BY DIRECT COMPARISON.

In order to apply this procedure, the calibration of the power meter must be known and accurate.

Step 1 - Connect the equipment as shown in Fig. 2.8. (General notes regarding interconnections appear in Section 2.4 of this manual).

Step 2 - Follow the Preliminary Operating Instructions listed in Section 2.5 of this manual.

Step 3 - Record the reading of the power meter.

Step 4 - Disconnect the MICROWAVE MEGA-NODE from the receiver being tested and connect a matched load across the receiver input.

Step 5 - Record the power meter reading.

Step 6 - Compute the noise figure, F, from the following formula;

$$F = \frac{38.29}{Y-1}$$

where Y is the ratio of the noise power recorded in step 2 to the noise power recorded in step 4.

Caution: Since noise contains components whose amplitude for brief periods may be much greater than rms noise power, great care should be taken to make certain that no overload occurs in the receiver, even at cw levels four times those of the noise levels encountered. It is also important to determine the law of the power indicator. Both the input-output characteristic of the receiver and the power indicator characteristic may be determined by measurements with a calibrated signal generator.

2.7 MEASUREMENT OF NOISE FIGURE BY INSERTED ATTENUATION TECHNIQUES.

By utilizing either a precision IF attenuator, RF attenuator, or both, the necessity for calibrating the receiver input-output characteristic is avoided.

A. By Use of an RF Attenuator.

If the noise figure of a receiver being tested is very low and its output capabilities limited, the full output power of the MICROWAVE MEGA-NODE may tend to overload the receiver.

Step 1 - Interconnect the equipment as shown in Fig. 2.9, omitting the IF attenuator. (General notes concerning interconnections are listed in Section 2.4 of this manual).

Step 2 - Follow the Preliminary Operating Instructions listed in Section 2.5 of this manual.

Step 3 - Set the gain of the receiver and the rf attenuator to give a convenient reading on the power output meter.

Step 4 - Disconnect the MICROWAVE MEGA-NODE and insert in its place a termination equal to the normal input impedance.

Step 5 - Adjust the attenuation until the power output meter reads ½ the value obtained in step 3.

Step 6 - Compute the noise figure, F, from the following formula:

for fluorescent lamps, F = (15.8 -a) db
for argon lamps, F = (15.3 -a) db
for neon lamps, F = (18.1 -a) db

where a is the attenuation obtained in step 5.

B. By Use of Two Attenuators.

Step 1 - Interconnect the equipment as shown in Fig. 2.9, inserting both attenuators. (General notes concerning interconnections are listed in Section 2.4 of this manual).

Step 2 - Follow the Preliminary Operating Instructions listed in Section 2.5 of this manual.

Step 3 - Insert 3 db into the IF attenuator and 20 db into the rf attenuator.

Step 4 - Adjust the gain of the receiver until a convenient reading is shown on the power output meter.

Step 5 - Disconnect the MICROWAVE MEGA-NODE and insert in its place a termination equal to the normal input impedance.

Step 6 - Remove the 3 db, inserted previously, from the IF attenuator.

Step 7 - Adjust the rf attenuator until the power output meter gives the same reading as that obtained in step 4.

Step 8 - Compute the noise figure, F, from the following formula;

for fluorescent lamps, F = (15.8 -a) db
for argon lamps, F = (15.3 -a) db
for neon lamps, F = (18.1 -a) db

where a is the attenuation obtained in step 7.

Since the power indicator is always operating at the same level and on the same kind of signal (noise) under both conditions of measurement, overload effects are less important and very simple power indicators may be used. This is true, however, only if the 3 db IF attenuation is introduced at a low level in order to keep the receiver operating in the linear portion of its characteristic. Under these circumstances, simple measurement of IF detector rectified dc voltage is a satisfactory indication of relative power output.

Another advantage of the above scheme is that normal RF attenuators may be adjusted to produce a high insertion loss. Consequently, with the lamp off and the attenuator at maximum (20 db or more), the receiver will "see" an input termination sufficiently close to the normal input impedance to eliminate the necessity of replacing the MICROWAVE MEGA-NODE with a matched termination.

C. By Use of an IF Attenuator.

Step 1 - Interconnect the equipment as shown in Fig. 2.9, inserting the IF attenuator only. (General notes concerning interconnections are listed in Section 2.4 of this manual).

Step 2 - Follow the Preliminary Operating Instructions listed in Section 2.5 of this manual.

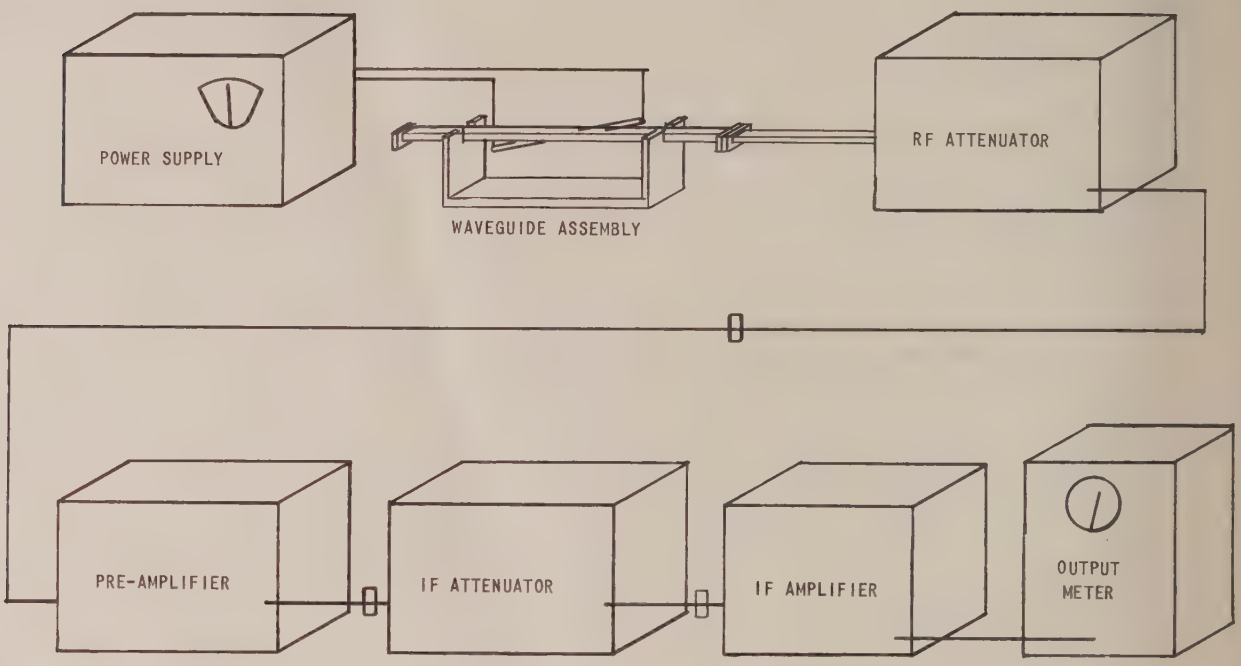


FIG. 2.9. INTERCONNECTION DIAGRAM FOR MICROWAVE MEGA-NODE USING INSERTED ATTENUATION TECHNIQUES.

Step 3 - Adjust the gain of the receiver until the power output meter gives a convenient reading, within the linear portion of its operating characteristic.

Step 4 - Disconnect the MICROWAVE MEGA-NODE and insert in its place a termination equal to the normal input impedance.

Step 5 - Adjust the IF attenuator until the power output meter gives the same reading as that obtained in step 3.

Step 6 - Compute the noise figure, F, from the following formula;

for fluorescent lamps, F = 15.84 -10 log (A -1) db
for argon lamps, F = 15.45 -10 log (A -1) db
for neon lamps, F = 18.0 -10 log (A -1) db
where A is the IF attenuation, expressed as a power ratio.

If spurious responses in the frequency range of the MICROWAVE MEGA-NODE are present, the receiver will accept noise from the MICROWAVE MEGA-NODE at the spurious frequencies as well as on the desired channel. When this is the case, a correction must be made to account for spurious receiver responses. If F is the measured noise figure and F_t is the true noise figure, both expressed as power rations, then;

$$F_t = F \frac{B}{B_u}$$

where B is the total bandwidth, including the spurious responses, and B_u is the useful channel in cps.

2.8 WAVEGUIDE TERMINATIONS.

It has been determined that the RG-48/U and RG-49/U diodes may be inserted in a section of line without introducing serious discontinuities provided that the lamp is in position and is turned *off*. That is, if these units are connected between a receiver and a matched load, they will present a matched load to the receiver both at room temperature (with the lamp turned off) and at 11,400°K for the fluorescent and argon lamps and 78,300°K for the neon lamps (with the lamp on).

For this reason, flanges have been provided at both ends of these guides on both the earlier and later models.

In the six other guides mentioned above, the discontinuities introduced by the de-energized lamp are more serious and prohibit the use of this technique. The condition of the unused end is unimportant.

The available noise power supplied to the receiver of the noise source is substantially independent of the termination at the end of the guide not attached to the receiver. This condition is brought about by the insertion losses introduced in the guide by the ignited lamp. The magnitude of these losses is such that substantially none of the power radiated away from the receiver and reflected from the opposite termination (whether short or open) will appear at the receiver end of the guide. The termination of the unused end is, therefore, unimportant with the lamp ignited, except for the possible leakage problem encountered with poorly shielded receivers. It would be possible to obtain full noise output from each end of the generator at the same time if desired.

SECTION III
THEORY OF OPERATION

3.1 GENERAL THEORY OF NOISE SOURCES.

The noise sources used in the MICROWAVE MEGA-NODES are commercial fluorescent, argon or neon lamps. In studying the utility of gas-filled lamps as a noise source, W.W. Mumford[1] has found that:

"In a gaseous discharge which is radiating light energy substantially monochromatically at a particular wavelength λ_m, the noise output at microwave frequencies is the same as that available from a black body which radiates its maximum energy at that wavelength."

The wavelength of maximum radiation for a black body may be determined from Wien's displacement law:

$$\lambda_m T = .289^\circ \text{ cm.}$$

where T = temperature of the radiating body in degrees Kelvin and

λ_m = wavelength in cm.

It has been shown that radiation from the mercury vapor discharge in a standard fluorescent lamp is concentrated in a single spectral line (λ_m = 2536.52 10^{-8}cm). No more than about 2% of the total energy is radiated at other wavelengths. Using this wavelength in the Wien law yields an equivalent lamp operating temperature (T_2) of 11,400°K. If Mumford's hypothesis is assumed to be true, this temperature represents a noise power of 15.84 db above the ideal available input noise power, kTB. (See discussion in paragraph 3.2). Measurements by Mumford check this result closely.

Mumford has found that the noise output of a fluorescent lamp is substantially independent of the fluorescent coating and of current density, but is slightly affected by temperature. Since these measurements of absolute noise output power were made with a guide temperature of 17°C, a temperature correction factor must be added to the calculated noise output of all fluorescent models for waveguide temperatures of different value. Several separate studies have arrived at a closely similar temperature correction factor of 0.05 db per degree centigrade. Each fluorescent noise generator unit of the MICROWAVE MEGA-NODES is equipped with a permanently installed thermometer for rapid determination of the temperature correction factor.

1 Mumford, W.W., "A Broad-Band Microwave Noise Source", Bell Systems Technical Journal, October, 1949, 606-619.

3.2 THEORY OF NOISE FIGURE MEASUREMENTS.

The thermal noise energy of an ideal conductor (one that generates no noise of its own other than that due to thermal activity of the individual electrons) may be stated as a function of the absolute temperature (T) in degrees Kelvin and the bandwidth (B) of the generated noise in cps. The available noise power from an ideal signal generator may be formulated as:

$$N = kTB$$

where k = Boltzman's constant = 1.38×10^{-23}

However, in any circuit incorporating a vacuum tube (as contrasted to an ideal conductor), an additional amount of noise will be generated as a consequence of the random electron travel in the tube. Then the noise figure of such a circuit - a measure of the additional noise generated in an actual rather than an ideal circuit - may be defined as:

$$F = \frac{\text{available input signal-to-noise power ratio}}{\text{available output signal-to-noise power ratio}}$$

This basic equation can be modified in a number of ways, depending on the method used for making the particular measurement. For example, if a signal generator is used as a power source, the equation may be modified to:

$$F = S_g/mkTB$$

where S_g is the maximum available signal power from the source in watts,

m is the ratio of signal power to noise power at the output of the circuit under test,

k is Boltzman's constant, 1.38×10^{-23}

T is the absolute temperature of the noise source in degrees Kelvin,

B is the bandwidth, over which the noise is observed, in cps.

If on the other hand, a hot-body noise source is used, the equation for noise figure may be written as:

$$F = \frac{([T_2/290]-1)}{(Y-1)}$$

where T_2 is the effective temperature in degrees K of the hot body and Y is the ratio of the noise power from network when the source is at T_2 to that when it is at room temperature.

Since T_2 for the lamps in use is 11,400°K,

$$\frac{T_2}{290} - 1 = 38.29 \text{ and}$$

$$F = \frac{38.29}{Y-1}$$

3.3 VSWR.

A low VSWR (and the insertion loss mentioned before) are obtained by tilting the tube at an acute angle to the guide. Although the lamp at any one point is not matched to the guide impedance, the reflections from the various points of the lamp (there are several wavelengths of the lamp in the guide) cancel each other out to a large extent. The actual impedance match of the lamp to the guide is modified only slightly by the lamp current. Good results may be obtained over the entire recommended operating range of a given waveguide by operating the lamp at the recommended currents.

One of the problems encountered in the use of fluorescent lamps as noise sources has been the presence of audio oscillations across the lamp. No method of eliminating the oscillations by external circuits is known, and, as can be seen from the curve on VSWR, the impedance match of the lamp to the guide is affected slightly by lamp current. If, then, the current varies at an audio rate, the impedance of the generator will vary at the same rate, and the power delivered by the generator to a constant load will be similarly modulated. However, in the MICROWAVE MEGA-NODES, where the lamp is mounted at an acute angle to the waveguide, the variation of impedance with tube current is extremely small. Since the actual tube current variations due to these oscillations are also small, the output impedance variation is negligible. It has not been possible to see other than random noise in the output of a receiver under test with these generators.

SECTION IV
MAINTENANCE

4.1 TROUBLESHOOTING.

The simplicity of the MICROWAVE MEGA-NODES eliminates the necessity for any elaborate maintenance procedure. The most frequent troubles encountered with these instruments are leaky capacitors, defective rectifiers, or gas tube failures.

The LAMP CURRENT meter and the front-panel light are the two main indicators on this unit.

If the indicator light does not come on when the ON-OFF switch is in the ON position, check the a-c supply, the front-panel FUSE (F-1), and the indicator light. If FUSE F-1 blows again on replacement, attempt to determine the cause of failure before replacing it a second time. Check particularly the electrolytic capacitor (C-1) and the rectifiers (D-1 & D-2).

If the meter still reads zero when the START switch is depressed, check the operating procedure (Section II). If all potentiometer settings appear to be correct, check the gas discharge lamps. To replace the lamp, remove the plugs from each end. The lamp may be removed by pressing against the lower end of the tube.

If the procedure outlined above does not correct the defect, de-energize the equipment and make the resistance and voltage checks on the power supply.

DWG. SYMBOL NO.	DESCRIPTION	KAY PART NO.
	Capacitors:	
C-1 A & B	40/40μF, 450V, ELECT.	6355-12
C-2	40μF, 450V, ELECT.	6355-13
C-3	NOT USED	
C-4 & C-5	0.02μF, 500V, CER. DISC	6360-7
D-1 & D-2	SILICON RECTIFIER F6	6357-3
F-1	FUSE 2A, 125V, SLOW BLOW	6755
I-1	INDICATOR LAMP, NEON	1753
	INDICATOR LAMP, HOLDER	1754
J-1	JACK, S-306-CCT	221
L-1	CHOKE, 4H	5500
M-1	METER, 0-300 MA	6758
P-1 A & B	PLUG, P-306-CCT	236
P-2	AC LINE CORD	328
	Resistors:	
R-1 THRU R-4	10 OHM, 2W, 10% TOL.	1001-H
R-5	560 K, $\frac{1}{2}$W, 10% TOL.	5641-F
R-6	300 OHM, 50W, WIREWOUND	3011-R
R-7	800 OHM, 50W, POT, WW	6843
R-8	400 OHM, 50W, WIREWOUND	4011-R
S-1	SWITCH, TOGGLE, DPST	1854
S-2	SWITCH, MOMENTARY, DPDT	4420
T-1	TRANSFORMER, VARIABLE	6759

4.2 REPLACEMENT PARTS.

The parts list for the MICROWAVE MEGA-NODE power supply is furnished in this section. To maintain new-circuit performance, use only exact replacement parts when making repairs. These are available from the Kay Electric Company when reference is made to the instrument type, serial number, circuit symbol number, and Kay part number.

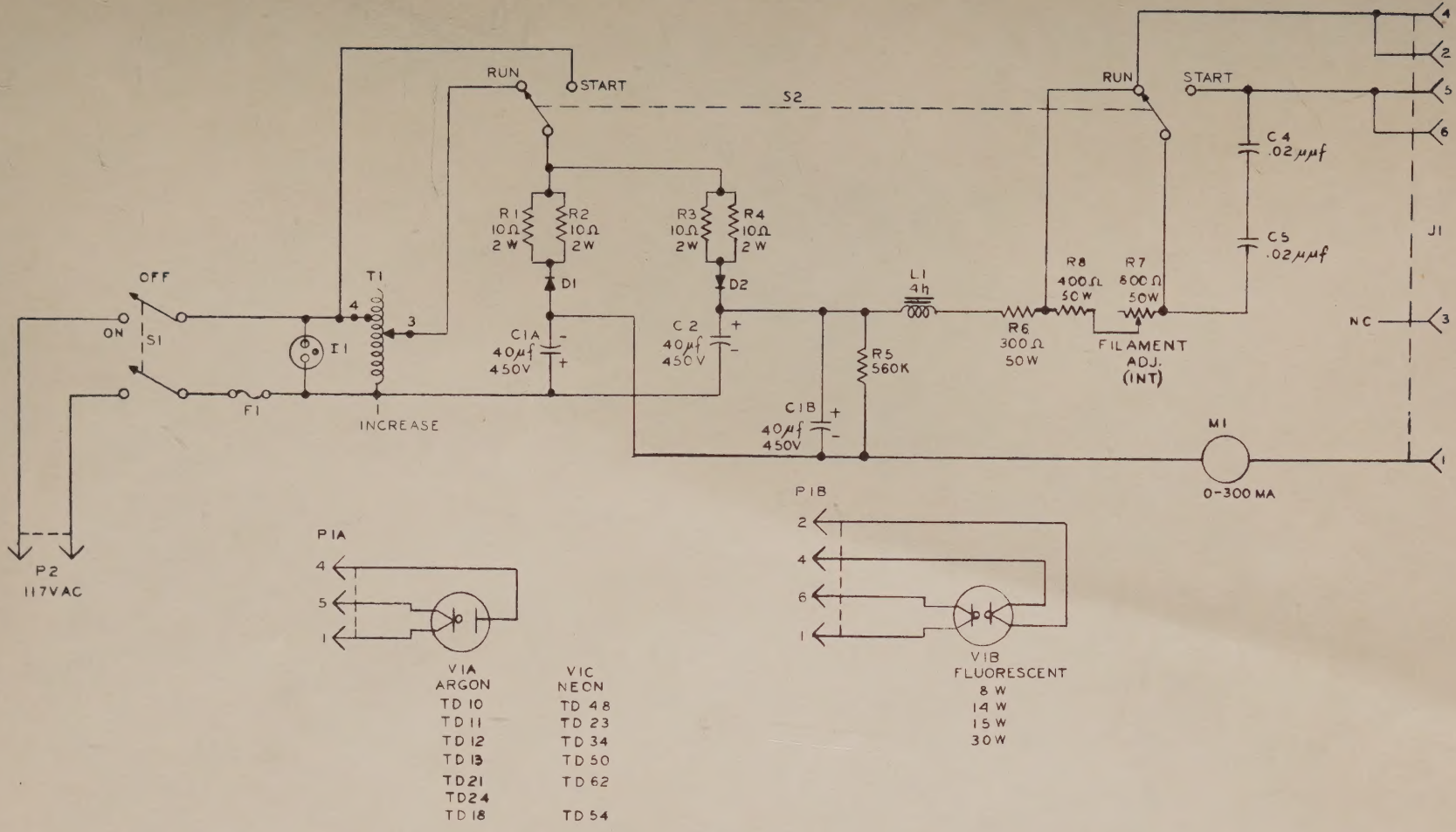
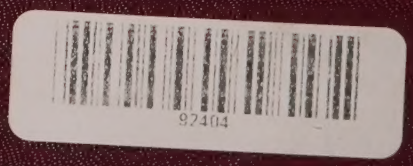


FIG. 4.1, MICROWAVE MEGA-NODE POWER SUPPLY, MODEL V, KB-6099-E.

AUA SERIAL NO. 21425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